Behavioral Competencies of Highly Regarded Systems Engineers at NASA

2009 PM Challenge
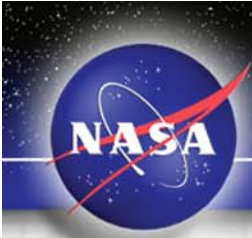
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Overview

- Background for study

- Behavioral Study of Systems Engineers
  Purpose and Methodology
  Behavioral Competency Model

- NASA Findings
  – How they differ from JPL findings

- Future Study Considerations

Background

March 2008, Agency-wide Systems Engineering (SE) Workshop held to discuss how NASA leadership could communicate a balanced picture of SE to those who work and interact with SE activities.

- Art and Science of SE – The "Monograph"

- SE Framework Deployment

- SE Workforce Development Strategy – Focus on:

  - Accelerating the development of next generation SE's: Systems Engineering Leadership Development Program (SELDP)
  - Identifying what makes a highly effective SE: SE Behaviors Studies Part I and II

- 37 of the most highly regarded SE's from across NASA were studied to identify the characteristics or behaviors that set them apart.

- Study data is being used to design or update SE training, development, coaching and mentoring programs to develop these behaviors in SE's across the agency.

- Share information to the SE community at large.

Methodology

- Nine NASA Centers participated.

- Study conducted by OD Specialists from Center's or APPEL .

- Duplicated the JPL Methodology Including:
  - One to two hour one-on-one interviews
    - All SE s were asked 8 behavioral questions and 2 questions for recruiting and succession planning purposes at JPL
    - NASA Study 13 questions on context, relation to self and personal awareness, and projecting forward
    - Interviews were tape-recorded and transcribed
  - SE's were Shadowed and Observed
  - Myers Briggs Type Indicator (MBTI) was Administered
  - Thematic analysis of common themes was conducted and information was grouped into clusters of competencies with associated behaviors
  - Concurrence with interviewees on overall competencies was sought.

Competency Model

Level	Description	Example	
Top: Theme	Collections of competencies	Problem Solving and Systems Thinking	
Middle: Competencies	Aggregations of related observable behaviors	Critical thinking	
Lowest: Actual Behaviors	Observable Behaviors	May visualize the systems as a whole, then breaks large aspects down into small pieces, then simplify these latter pieces into even smaller pieces. Slices the pieces horizontally, vertically & diagonally to see connections & soft spots. Rebuilds parts into a whole. Navigates complexity on multiple dimensions & layers. See the big picture & the sum of its parts.	

NASA SE Behavioral Competency Model

Leadership	Attitude & Attributes
Appreciates/ Recognizes Others	Remains Inquisitive and Curious
Build Team Cohesion	Seeks Information and Uses the Art of Questioning
Understands the Human Dynamics of a Team	Gains Respect Credibility, and Trust
Creates Vision and Direction	Advances Ideas
Ensures System Integrity	Possesses Self-Confidence
Possesses Influencing Skills	Has a Comprehensive View
Sees Situation Objectively	Possesses a Positive Attitude and Dedication to Mission Success
Coaches and Mentors	Is Aware of Personal Limitations
Delegates	Adapts to Change and Uncertainty
Ensures Resources are Available	Uses Intuition/Sensing
	Is Able to Deal with deal with Politics, Financial Issues, and Customer Needs

NASA SE Behavioral Competency Model

Communication	Problem Solving and Systems Thinking
Listens Effectively and Translates Information	Identifies the Real Problem
Communicates Effectively Through Personal Interaction	Assimilates, Analyzes, and Synthesizes Data
Facilitates and Environment of Open and Honest Communication	Thinks Systemically
Uses Visuals to Communicate Complex Interactions	Has the Ability to Find Connections and Patterns Across the System
Communicates Through Story Telling and Analogies	Sets Priorities
Is Comfortable with Making Decisions	Keeps the Focus on Mission Requirements
Technical Acumen	Possesses Creativity and Problem Solving Abilities
Possesses Technical Competence and Has Comprehensive Previous Experience	Validates Facts, Information & Assumptions
Learns from Successes and Failures	Remains Open Minded & Objective
	Draws on Past Experiences
	Manages Risk

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MBTI Results

- 25 Participants Completed MBTI and Temperament

- Emerging Overall Patterns

- 9 types identified:
  - ISTJ, INFJ,INTP,ENTP,INTJ,ENTJ, ISTP,ESTP, ESFP

- All temperaments represented: SJ, NT, NF, SP

- Conclusions

Future Considerations

- Participants felt in ten years the art of SE and needed SE behaviors would remain the same, process and tools might be different, and the systems themselves would be larger and more complex.

  - Study Systems Engineers who are not considered "highly regarded" and compare differences.
  - Study when Systems Engineers began to realize they were systems thinkers i.e.: age, family influences, environment.
  - Compare job assignments/work experience across participants to see if there is any correlation between type of assignments and Systems Engineering success.

Two competencies showed up in NASA Vs JPL

– More Face to Face Interaction
– Greater Use of Charts and Visuals

- The NASA SE Behaviors Study and all Center Specific Reports are Available on the NASA Engineering Network at:

(http://www.nasa.gov/news/reports/NASA_SE_Behavior_Study.html).

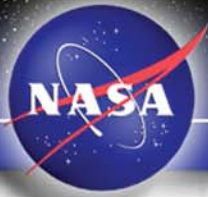- Summary Article Published by Talent Management Magazine January/February 2009.

Behavior Study Part II

- NASA has expanded this effort to include a study of Executive SE Behaviors to Answer the Question:

  – What behaviors do highly effective SE executives use to achieve success?

- 18 Executives NASA-wide are currently being studied and results are expected by April 2009.

Backup Charts

Theme: Leadership

Competency	Example of Actual Behaviors
Appreciates/Recognizes Others	Articulates the relevance of the team's work and its overall contribution to the success of the program and organization.
Builds Team Cohesion	Models open, non-defensive behavior with others.
Understands the Human Dynamics of a Team	Genuinely respects people and their talents by encouraging and challenging them to do their best work.
Creates Vision and Direction	Keeps the team on track by holding a big picture view of what needs to be accomplished in order to reach mission requirements.
Ensures System Integrity	Understands the integrity of the system is a primary role. Makes system planning decisions accordingly, reporting unacceptable project risks to senior management.
Possesses Influencing Skills	Influences actions of personnel not under their direct management control by creating synergy among and with people.
Sees Situations Objectively	Understands some of the best ideas can come from a mix of people. Does not assume there is only one right answer.
Coaches and Mentors	Challenges individuals to do their best work by giving assignments that build their capabilities.
Delegates	Delegates responsibility and authority to the lowest possible levels while retaining control of sub-system requirements and system integration functions.
Ensures Resources are Available	Ensures team has the right tools, knowledge, and resources in order to get the job done.

Competency	Example of Actual Behaviors
Remains Inquisitive and Curious	Is naturally inquisitive and curious, and is largely driven by that curiosity. Is fearless and has an authentic and persistent desire to understand how everything works and how it relates to everything else.
Seeks Information and Uses the Art of Questioning	Asks questions artfully. Uses a series of questions that build upon each other to help identify the root of a problem or solutions.
Advances Ideas	Engages the team by explaining how the solution or approach was reached.
Gains Respect Credibility, & Trust	Demonstrates understanding and appreciation of the challenges others face.
Possesses Self-Confidence	Willing to speak up, regardless of who is present to ensure the most technically sound decision is made for the good of the overall system.
Has a Comprehensive View	Takes responsibility for the whole life cycle, the whole system and all its parts. Understands the whole job and that it is never done.
Possesses a Positive Attitude and Dedication to Mission Success	Encourages a success oriented environment by displaying passion, excitement and enthusiasm about the work and the challenges faced by the system
Is Aware of Personal Limitations	Seeks guidance from experts. Knows what they know and what they don't know and seeks others to fill in missing data.
Adapts to Change and Uncertainty	Understands that change is inevitable and takes appropriate actions quickly. May assemble other technical experts to brainstorm various avenues and approaches to support the change.
Uses Intuition/ Sensing	Uses both intuition and sensing when evaluating a problem or making a decision. Does not rely solely on data. May use "gut feeling" if data is inconclusive.
Is Able to Deal with Politics, Financial Issues, and Customer Needs	Shares and uses knowledge and expertise that shapes the political and financial environment in positive ways.

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Theme: Communication

Competency	Example of Actual Behaviors
Listens Effectively and Translates Information	Sees the system from various perspectives. Listens and acts as translator between parties (subsystems, Project, vendors and other customers), ensuring each gets the necessary information from others.
Communicates Effectively Through Personal Interaction	Prefers personal interaction over email. Uses face-to-face interaction as a primary communication channel to hear concerns, share information, build rapport, create buy-in and create relationships within a team.
Facilitates an Environment of Open and Honest Communication	Patiently listens to each of the team members/discipline experts in order to assure that everyone gets heard--that all diverse and dissenting opinions are considered. Listens to all who want to speak, does not communicate irritation and does not shut people down.
Uses Visuals to Communicate Complex Interactions	Graphically pulls together ideas, issues, and observations to better understand and explain all systems and interfaces and to solve complex problems.
Communicates Through Story Telling and Analogies	Uses personnel experiences to build connections and provide explanations by using engineering and non-engineering stories and analogies.
Is Comfortable with Making Decisions	Makes decisions in a confident and timely manner when appropriate--with or without complete or optimal information--allowing team members to maintain forward progress on their assigned tasks.

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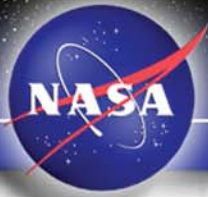# Theme: Problem Solving & Systems Thinking

Competency	Example of Actual Behaviors
Identifies the Real Problem	Identifies the critical problem to be solved by asking questions and identifying the key requirements.
Assimilates, Analyzes, and Synthesizes Data	Breaks data into smaller pieces or parameters, prioritizes the parameters, then synthesizes the data to reach an answer or solution.
Thinks Systemically	Looks across the entire system and facilitates trades and compromises to get a balanced design.
Has the Ability to Find Connections and Patterns Across the System	Examines and explores the implications of how technical decisions being made affect the bigger system architecture. Sees the ripple effect of changing requirements or making changes to any element of the system.
Sets Priorities	Sets technical and priorities in order to maintain the balance for the problems at hand while achieving system requirements.
Keeps the Focus on Mission Requirements	Studies, understands, and articulates the project's overall objectives. Knows what the system must do and be in order to accomplish its objectives.
Possesses Creativity and Problem Solving Abilities	Does not adhere to rigid rules or formulas for system design, but may create new ideas and approaches that are necessary to deal successfully with system constraints.
Validates Facts, Information and Assumptions	Questions all assumptions that go into the design.
Remains Open Minded and Objective	Evaluates decisions objectively. Maintains flexibility by avoiding 'ownership' of a particular strategy or point of view.
Draws on Past Experiences	Uses experience, history, intuition, and sensing in order to assess the situation and develop a solution.
Manages Risk	Develops mitigation strategies for addressing the problems, should they arise.

Competency	Example of Actual Behaviors
Possesses Technical Competence and Has Comprehensive Previous Experience	Demonstrates the depth of technical knowledge and expertise necessary to perform, manage, and coordinate work-related activities.
Learns from Successes and Failures	Shares with other lessons learned. Lessons come from a strong base of engineering experiences across the full life-cycle.

MBTI Results

INFJ **Forseer/Developer** **25,6,3,28**	INFP Proponent/ Advocate	ISTJ **Overseer/** **Inspector** **7,11,28,29** **26,26,30,30**	ISFJ Provider/ Nourisher
ENFJ Forseer/Mobilizer	ENFP Proponent/ Messenger	ESTJ Overseer/ Supervisor	ESFJ Provider/ Caretaker
INTJ **Forseer/Mobilizer** **5,10,7,6** **18,6,24,8** **17,8,25,25** ** (scores not available)	INTP **Inventor/** **Designer** **30,5,5,19** **12,16,15,8** **16,24,30,2** **4,16,14,12** **11,9,14,11** **4,9,6,1** ** (scores not available)	ISTP **Maneuverer/** **Operator** **19,6,8,2** **29,5,27,2** **6,14,18,3**	ISFP Performer/ Composer
ENTJ Director/ Commandant	ENTP **Inventor/** **Improviser** **12,8,5,14** **15,4,6,7**	ESTP **Maneuverer/** **Promoter** **30,5,24,1** **16,3,1,2** **25,5,8,12** **14,26,5,6** **17,10,20,12**	ESFP **Performer/** **Entertainer** **8,19,3,4**

NASA Interview Questions

- Context Questions
  - How would you describe the role of the SE?
  - On a scale of 1 to 10, how important is the SE in the success of a program/project?
- Relation to Self and Personal Awareness
  - Create, in behavioral terms, statement that would describe you as a SE
  - Identify the attitudes and attributes a "highly regarded" SE possesses
  - What leadership behaviors does a " highly regarded" SE possess?
  - As a SE, what leadership abilities do you possess?
  - On a scale from 1 to 10, how important are these abilities to mission success?
  - What values drive you as a leader?
  - How are these values reflected in your attitude?
  - Describe what goes on in your mind when you are problem solving
- Projecting Forward
  - What do you look for in determining if someone will make a good SE?
  - How will the job of an SE be different 10 years from now?
  - What will the future SE need to know and do differently?

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